Dating and provenance of loess by luminescence and ESR

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Natural crystals contain a vast number of point defects, which may be either intrinsic or due to impurities. Some of these defects remain unchanged under ionising radiation bombardment by the omnipresent natural radioactivity, while others are being transformed, generally by charge trapping. Based on the dynamics of these radiation sensitive defects under irradiation, natural minerals such as quartz and feldspars can record the amount of ionising radiation they have been exposed to as a latent signal within their crystal lattice. This signal can be excited and quantified by controlled heating or light exposure, as well as by subjecting the sample to a magnetic and microwave field. As such, quartz or feldspars can be successfully used for dating sediments by thermoluminescence (TL) or optically stimulated luminescence (OSL) well as by electron spin resonance (ESR). As there are many defects available, trapped charge dating methods such as luminescence or ESR are very dynamic research fields, new methodologies being constantly developed. Dating applications rely on the fact that following the deposition and burial of the sediment, when signal resetting occurs, the exposure to natural radioactivity causes a steady increase in luminescence and electron spin resonance signals with time. The assumption on which these methods are based on is that the signal growth in nature can be reproduced by performing controlled laboratory irradiations. The moment to be dated by these methods is the moment of sediment deposition, when the signal used is set to zero by light exposure. As such, loess is an ideal material for the applications of these methods. The time frame of applicability ranges from the recent past to a few hundred ka, depending on the sample, method and measurement protocol used. Moreover, besides dating, these luminescence and electron spin resonance signals have been found recently to be useful for fingerprinting the sources of the sediments and are currently investigated as sediment tracers. In this contribution we will present the basic principles behind these methods and exemplify their use in loess research studies.